

PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

149th Session (1936-7)

Part 2

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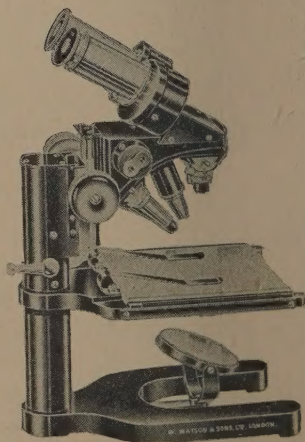


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PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

149th Session (1936-7)

Part 2

GENERAL MEETINGS

7 JANUARY 1937

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 10 December 1936, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted:—Amos Perry.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Gian Singh Bhatia, Harold Geoffrey Wager, the Hon. William Jocelyn Lewis Palmer and Margaret Trevena Martin; for the first time, in favour of David Russell.

Studies in South African Volvocales. By Dr. MARY AGARD
POCOCK, F.L.S. [Abstract.]

1. *A new Sphaerella* (Haematococcus).

De Klip, an isolated granite outcrop in the Cape Flats to the north of Zeekoe Vlei, is botanically of very great interest. In the rock crevices grow many succulents, the grassy hollows yield a wealth of bulbous plants besides such rarities as a terrestrial *Isoëtes* and the alga *Oedocladium*, while in the series of pools which form against the rock there is a rich algal flora associated with an interesting micro-fauna. In addition, on the rock itself rain-water collects in several shallow pans, and in one of these a new *Sphaerella* flourishes.

Issued 16 June 1937]

This species differs from all previously described species of *Sphaerella* in the presence of only one pyrenoid in the cell, and is closely related to *Sphaerella droebakensis* Wollenweber, which possesses two pyrenoids. It has also been found in pools in quartzite near Darling and on Muizenberg Mountain.

At De Klip it passes rapidly through its life-cycle, which culminates in sexual reproduction. In asexual reproduction the protoplast divides into usually four (but sometimes two or eight) zoospores, one of which remains attached to the parental flagella, which it activates even while developing its own flagella and eye-spot at its inner end. Thus the are parent cell continues motile, while all but the one zoospore already moving within the cell-wall. In sexual reproduction, too, the cell is motile until after the completion of cell-division; here, however, the number of divisions is much greater, resulting in the formation of a hollow cup of small cells, which are in protoplasmic connection with one another. After division is completed the cells break apart, forming small spindle-shaped gametes which swarm vigorously within the parent membrane. This is soon ruptured, the gametes escape, swim actively in the water, and soon begin to conjugate in pairs. The quadriciliate zygotes remain active for some time.

The behaviour of this organism during gamete-formation is very similar to that of the germinating zoospore of *Volvox Rousseletii*.

2. Fertilization in *Eudorina elegans*.

Actual fertilization in this species of *Eudorina* has not been recorded previously, although Meyer has described fertilization in a monoecious species, *Eudorina monoica*, from Russia. The female colonies come to rest, the wall gelatinizes, and the large eggs lie quiescent in the mucilaginous matrix, gently waving their flagella. The spermatozoid bundles escape from the male colonies, swim actively in the water, and are eventually attracted to the mature female colonies, on the surface of which they disintegrate. The spermatozooids work over and eventually penetrate the mucilaginous surface, swarming round the eggs. Ultimately one makes contact with the egg, the apex of the spermatozoid fusing with that of the latter; fusion proceeds rapidly backwards until the body of the spermatozoid has entirely disappeared into that of the egg. The two male and the two female flagella (the latter only slightly the longer) continue to move gently for some time, so that the zygotes are easily distinguished from the unfertilized eggs. Eventually a wall is formed and the resting zygospore matures.

3. *A new species of Volvulina Playfair.*

This imperfectly known genus has hitherto been recorded only from Australia, the Amazon, and the neighbourhood of Leningrad. In 1932 it was first noticed by the writer among *Eudorina* collected from a rainwater pool on the Cape Flats; since that date it has been collected repeatedly from most of the *Volvox* pools of the district, and has also been raised in soil cultures in the laboratory. It is a small colonial alga very similar to *Eudorina*, but differing from it in several important points, notably in the structure of the colony and in the absence of pyrenoids from the cells.

The species from South Africa is unique in the possession of four (more rarely two) small directive cells at the posterior pole. Asexual reproduction is by the formation of daughter colonies from all except the four small posterior cells, which never divide, but, unlike all other colonial Volvocales hitherto investigated, there is no process of inversion in their development. From the beginning of cell-division the nucleated apices of the daughter cells are directed outwards. The parental flagella remain attached to two of the daughter cells, while the eye-spot is often conspicuous in yet a third. Thus the colony continues actively motile even after all the daughter colonies are fully mature with well developed active flagella.

In sexual division the cells of the colony form gametes without undergoing division; these are of two sizes, the smaller usually much paler in colour. They escape into the water, where they eventually fuse to form quadriciliate zygotes, which are at first active but soon settle down and begin to secrete a wall. This species thus shows heterogamy as opposed to the marked oogamy of *Eudorina*, in that respect being closely comparable with *Pandorina*.

In structure and reproduction this form stands alone among the colonial Volvocales, and possibly represents an entirely distinct line of evolution from that of the *Gonium-Eudorina-Volvox* series.

Prof. F. E. FRITSCH expressed admiration for the way in which Dr. Pocock had elicited the details of the forms dealt with and for the manner in which she had presented her communication. Whether her *Sphaerella* was a new species or not, it was of great interest as constituting a further link with the genus *Chlamydomonas*, from which *Sphaerella* was once thought to be so far removed in cell-structure. In this connection he would like to ask about the form of the chloroplast; was it basin-shaped? *Volvulina* presented many points of great interest. He did not think that the absence of inversion was its most striking feature. It was most

peculiar, he thought, in its polarity, which was, so to say, 'the wrong way round', seeing that the vegetative cells were at the posterior pole. Perhaps this unusual polarity was connected with the absence of inversion.

Mr. D. J. SCOURFIELD asked whether the South African species of *Sphaerella* described by Dr. Pocock ever turned red as the common British species so frequently did.

Sir ARTHUR HILL asked whether, in view of what Dr. Pocock had said about the desirability of preserving De Klip and the adjacent portions of the Cape Flats, which are so rich both in their interesting fauna and flora, it would serve a useful purpose if the Linnean Society could pass some resolution advocating the preservation of the area. Dr. Pocock, in reply, said there was great danger of this part of the Cape Flats being destroyed by building operations and by quarrying of the granite rocks. Sir Arthur then proposed that the Society should pass a resolution and forward it to the proper authorities at the Cape, pointing out the great desirability of preserving this interesting area from further destruction and forming it into a nature reserve. He agreed, on the suggestion of the President, to forward a memorandum to the Council so that they might take the necessary action.

Mr. S. GARSIDE supported Sir Arthur Hill's motion.

In reply to Professor Fritsch, Dr. Pocock said: 1. The chloroplast in the African *Sphaerella* is somewhat irregular, but apparently more or less basin-shaped. 2. Although Goroschankin's paper on *Eudorina* was not accessible, Meyer, himself a Russian, presumably had access to it, since he refers to Goroschankin's work, and he accepts Iyengar's statement that actual fertilization had not been observed. 3. While admitting the importance of the cell-differentiation in the *Volvrulina* colony, the absence of inversion in colony formation nevertheless seems of paramount importance since it results from a fundamental difference in the mode of cell-division during the process.

In reply to Mr. Scourfield Dr. Pocock stated that haematochrome sometimes occurs in the De Klip *Sphaerella*, but never to the same degree as in *Sphaerella lacustris*, and quite often the cells show none at all.

In reply to Sir Arthur Hill Dr. Pocock said that the suggestion that the Linnean Society should propose the formation of nature reserves on the Cape Flats was most heartily welcomed, as this region is rapidly being built over or put under cultivation, with the result that very little of the native flora now remains. Even in the last three or four years several *Volvox* pools have disappeared, while in only a few small areas does the 'Flats Flora' survive comparatively undisturbed.

The determination of size in plants.

By Dr. ERIC ASHBY, F.L.S.

THE problem of how size is determined in organisms has been approached from three directions: (i) by a discussion of the limits set to size by the geometrical and physical properties of cells and organs, (ii) by an analysis of the relation between the size of a part of the organism and the size of the whole, and (iii) by investigating the developmental processes which establish the particular size of an organism. My subject is this third approach to the problem, but by way of introduction I may mention the first two methods of investigation.

(i) The upper and lower limits of size may be predicted with some precision from the physical properties of structures. Thus, the size of an individual cell must be limited by its ratio of surface to volume. The maximum length of a leaf or the maximum height of a tree may be determined from a knowledge of the modulus of elasticity of the material, its specific gravity, and the area of cross-section. For instance, Poynting and Thomson (1920) have shown that the maximum height of a pine-tree 15 cm. in diameter is 81 feet. There are other elegant calculations of this sort, but they are of little more than academic interest, for the sizes of most plants lie well within their theoretical limits, and there are many ways in which living things transcend these limitations,—cells by increase of surface by involutions, trees by increase of girth or by the buttressing found in tropical forests. Clearly a solution of the problem of size-determination does not lie this way.

(ii) The second approach has been made by zoologists more than by botanists. It involves finding the relation between the part and the whole of an organism: antlers and body-weight in stags, claw-length and body-length in crabs, leaf-size and shoot-size in plants. The data given are often very consistent (see Huxley, 1932, Ashby and Luckwill, 1937); but this is only a formal description of size, and does not throw much light on its causes. In fact, as Sinnott has shown for squashes (1935) the ratio of one dimension to another in an organism, i.e. the shape, is often independent of the actual size.

(iii) The third way of approach is through a study of rates of development. For the formal analysis of rates we require growth-curves. Now the simplest way to analyze growth-rates is to regard the continued division of a group of cells as a capital sum accumulating at continuous compound interest, the rate of interest being the frequency with which a cell divides, and the capital being the initial size of the primordium. So long as the same proportion of the cells remains active in division the rate of interest remains constant.

As differentiation proceeds one cell after another becomes fixed, unproductive; it ceases to earn interest, and the rate of interest falls. V. H. Blackman (1919) showed that this idea could be extended to the increase in dry weight of plants, which is a good estimate of growth, since it measures the amount of carbohydrate fixed by the plant. In the experiments we have done on growth-rates we have simplified matters by measuring growth only over the period when the rate of interest remained constant (from germination to the onset of flowering in many annuals), or by choosing colonies of plants where the rate of interest remains constant indefinitely (e.g. *Lemna*).

We can accordingly analyze size conveniently into three determinants: (i) initial capital of dividing cells, (ii) rate of interest, (iii) the period over which the rate of interest is maintained, i.e. up to the onset of senescence. Each of these three determinants is in turn dependent upon two variables: the genetic constitution of the plant and the environment in which it is grown. In the following paragraphs I shall briefly indicate what is known in the several categories of this analysis.

A. EFFECTS OF ENVIRONMENT.

(i) *On capital*.—The initial capital is the fertilized egg. Measured as cell number, therefore, all plants begin as unity. Now we know scarcely anything about the rate of growth of the embryo from fertilization to the condition of a resting seed (but see Tukey, 1933). So far as the plant is concerned we must consider the embryo before germination as the effective capital. In order to estimate this capital it is necessary to dissect away the root- and shoot-primordia apart from the stored food and non-meristematic parts of the seed. Is the size of these primordia changed by changes in the environment? So far as our data indicate the answer is, No. The weight of primordia in any one strain is fairly constant whatever the environment has been during embryonic development. This is in contrast to the total *seed*-weight, which can be increased by a favourable 'maternal' environment. We find that by removing all the inflorescences except one from a bean plant we harvest bigger seeds, but the bigger seeds do *not* contain bigger embryos. Facts such as these probably account for the conflicting evidence of the effect of seed-size on final yield in plants. When the seed-weight is due principally to the *embryo* one expects seed-weight to be correlated with yield; when most of the weight of the seed is due to non-meristematic material there is no necessary relation between seed-weight and yield. We need more evidence on the question, but the present indication is that the embryonic

capital is relatively unresponsive to changes in the environment, and is determined by hereditary factors.

(ii) *On rate of interest.*—In contrast to this the rate of interest is extremely sensitive to environmental changes. Light, temperature, nitrogen, water, all these may increase the rate of cell-division and the rate of accumulation of carbohydrates. In Table I. some examples are given of the effects of various factors on the rate of interest in colonies of *Lemna* (Ashby and Oxley, 1935, and unpublished data).

TABLE I.

Light.	r.	Temp.	r.	Nitrate.	r.	Potash.	r.
80	0.068	10	0.034	0	0.101	1	0.329
350	0.139	18	0.083	1	0.231	20	0.345
500	0.152	24	0.149	5	0.302	100	0.336
750	0.169	29	0.191	25	0.305	200	0.336

'r' represents rate of interest. Light was measured as foot-candles, temperature as degrees C., nitrate and potash as milligrams per litre.

One can imagine, however, a sort of plant paradise, where every environmental factor is present in adequate measure; under these conditions the growth-rate is determined by the plant's capacity to grow, i.e. by its inheritance.

(iii) *Senescence.*—The onset of senescence, again, is not easily postponed by changing the environment, except in so far as the time of sexual maturity is changed. Where the onset of flowering can be delayed senescence may often be indefinitely postponed. Fruiting is the signal for slowing down of development, but it cannot be regarded as the *cause* of this slowing down. There is some evidence (see Kidd, West and Briggs, 1921) that in senescence there is, independently of the environment, a running down of metabolism, as measured by the respiration rate of the apical meristem.

Environment therefore affects plant-size chiefly through the rate of interest, which is very sensitive to its changes. Capital, and to a lesser extent the time of onset of senescence, are relatively insensitive to changes in the external environment. This conclusion is reflected in the fact that the treatments used in agriculture to increase vegetative yield are treatments designed to increase the rate of interest of cell-division and assimilation-rate.

B. EFFECTS OF GENETIC CONSTITUTION.

(i) *On capital.*—Again, on account of our ignorance of the course of embryonic growth in plants we must take as the capital the embryo in the resting seed. This, although relatively insensitive to the environment, varies greatly

according to the genetic constitution. The weight of primordia in strains of maize varies from 0.019 to 0.050 grams, and the weight is characteristic of the particular strain. It is determined by genetic factors and shows evidence of segregation in breeding experiments. One may therefore breed for large or small capital in plants. Although determined by hereditary factors the embryo-size is dependent also upon the *maternal* environment, for we have found that the sizes of embryos of the same genetical constitution (from reciprocal F_1 crosses) differ in different maternal environments (Ashby, 1932). This is illustrated by the data in Table II.

TABLE II.

Plant.	Female parent.	Male parent.	Weight of primordia.
Maize	Strain A	Strain B	0.0378 gm.
	Strain B	Strain A	0.0429
Tomato	Strain A	Strain B	0.00139 gm.
	Strain B	Strain A	0.00101

These differences in embryo-weight may not amount to more than a fraction of a milligram. What effect do such differences have on final size? Recent work has shown that in many instances big differences in final size are not due to differences in rates of interest, but mainly to a slight advantage or disadvantage in the weight of primordia in the embryo. The principle holds for animals as well as plants: large advantages in size, as between Flemish Giant and Polish rabbits, are often due solely to the maintenance of a slight initial advantage in birth-weight. Some data on this point are brought together in Table III.

TABLE III.

Organism.	Weight at birth or germination.	Ratio 'a' to 'b'.	'Final' weight.	Ratio 'a' to 'b'.
Maize	Strain a 0.013 gm.	—	17.40 gm.	—
	„ b 0.045	3.85	66.0	3.79
Tomato	„ a 0.00049 gm.	—	4.71 gm.	—
	„ b 0.00136	2.77	4.96	1.83
Pig	„ a 3.15 lb.	—	186 lb.	—
	„ b 3.95	1.25	228	1.22
Mice	„ a 4.95 gm.	—	26 gm.	—
	„ b 6.00	1.21	31.25	1.20

It is clear that the considerable final differences in weight were already established in the 'capital', and in one instance (in tomatoes) some of the initial difference in size has been lost during growth.

It seems that the initial size is of the greatest importance in determining final size, and that these minute differences in capital, governed by genetic factors, may be the sole cause of big differences later in the life-cycle. The same is true in some instances of the parts of plants. Houghtaling (1935) has shown that differences in size of tomato fruits are already present in the flower-bud. In nearly all of these examples the size-differences are due to differences in cell-number, and not in cell-size.

(ii) *On rate of interest.*—Since the rate of interest is so sensitive to changes in the environment it is necessary to grow different strains of plants under exactly the same environment in order to discover whether rate of interest is determined genetically. When this is done one finds that generally speaking there is very little variety in rate of interest among different strains of the same species. Most pedigree strains of tomatoes, for instance, have the same rate of interest. Several races of rabbits and guinea pigs used for genetical experiments show the same consistency of rates of interest. We have, however, a few instances of races which vary in their rates of interest. When some of these races are crossed the higher rate of interest appears as a dominant in the F_1 generation, and in the F_2 there is evidence of a segregation of rates of interest, depending on genetic factors. In fact dwarfness in *Gammarus* has been attributed in one instance to a lower average rate of interest, controlled by one factor-pair, and segregating into a 3 : 1 ratio in the F_2 generation (Ford, 1928). The following table contains relative growth-rates (rates of interest) of several organisms and the first generation hybrids between them (Ashby, 1937).

TABLE IV.

Maize :	parent 1	0.0692
	parent 2	0.0965
	F_1 hybrid	0.0956
Tomato :	parent 1	0.184
	parent 2	0.177
	F_1 hybrid	0.182
Rabbits :	parent 1	0.513
	parent 2	0.632
	F_1 hybrid	0.633

Not all instances are as clear-cut as these ; often the inheritance of rate of interest is intermediate between those of

the two parents, and is probably governed by several genetic factors.

(iii) *Senescence*.—The difference between some so-called tall and dwarf forms of plants is really a difference in the time of onset of senescence. Tall and dwarf tomatoes, for instance, may grow at the same rate, and even weigh about the same until after flowering. Then the tall variety grows on and the dwarf enters the phase of senescence. We have some evidence of this for tomatoes, and have found that the delayed senescence is dominant to the early senescence. Emerson (1916) found the same for beans, and other instances occur in the literature.

CONCLUSIONS.

The foregoing data are too fragmentary to be drawn into any general conclusion, but we may summarize them as follows: Heredity controls plant-size (and possibly also animal-size) chiefly through determining the initial sizes of primordia. The subsequent rates of development of these meristems are often the same in organisms of greatly differing size. There are cases on record (see Gregory and Castle, 1931) where the sizes of two strains of rabbits are already largely determined forty hours after fertilization, and many cases where the sizes of plants are determined in the resting seed. It seems as though the genes for size act very early in development, and affect what we have arbitrarily called 'capital'. The common variables of the environment, on the other hand, affect size by increasing or decreasing the rate of interest, i.e. the relative growth-rate.

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Professor R. R. GATES said that Dr. Ashby had made some notable contributions to the subject of the physiology of size-

inheritance, and had brought out some interesting new relationships in the analysis of the respective rôles of heredity and environmental factors in determining size. The speaker was at one time engaged in work on the inheritance of flower-size, and showed incidentally that the mean petal-length of the flowers on a plant varied from day to day with the mean temperature. Dr. Ashby's analysis made it clear that dominance played a part in the phenomena of heterosis, and that size-differences arose very early in development, the 'rates of interest' remaining constant. Was it possible that differences of size, e.g. in varieties of rabbits or of flowering plants, began with the egg-cell itself?

Professor E. J. SALISBURY and the PRESIDENT also spoke; and Dr. ASHBY replied.

21 JANUARY 1937

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceeding of the General Meeting held on Thursday, 7 January 1937, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of David Russell; for the first time, in favour of Charles Kirke Swann.

The PRESIDENT reported the deaths of Alfred Eugène Craven and Dr. Robin John Tillyard, F.R.S., Fellows of the Society.

Dr. REINHARD DOHRN, Director of the Zoological Station, Naples, gave a short account of the origin of the Station and its long connection with British Biologists. The President added some remarks.

The light relations of *Euglena limosa* Gard.—Part 1. The influence of intensity and quality of light on phototaxy.
By Dr. ROSE BRACHER. [Abstract.]

Euglena limosa, a species without flagellum, lives on tidal mud of a definite water-content (98 per cent.). It can travel

over the surface of the mud and burrows periodically below the surface. The burrowing is controlled by a number of external factors, of which the most important are darkness and the approaching high tide.

Experiments were carried out which showed that the light-intensity at which *Euglena* burrows is from 30–40 foot-candles. A somewhat higher intensity is required to bring the organisms to the surface, namely, 50–60 foot-candles. The measurements were made with a Weston photronic photo-electric cell.

Another series of experiments was performed concerning the effect of wave-length of light on the movements of *Euglena*. It was found that a narrow band of wave-length from 4200–4600 Å.° was the most effective in producing a response. That wave-length is more important than total energy was best shown by a comparison of the effect under two red filters in which the distribution of transparency and the energy is nearly equal. The one under which a response occurs has a weak band in the region 4200–4600 Å.°, while the one under which no response occurs has not.

In the course of the experiments some interesting data were obtained concerning the interaction of factors and their effect on the behaviour of *Euglena*. A slight stimulation by two factors, each of which is insufficient alone to bring about a response, will do so if operating together.

Professor MACGREGOR SKENE expressed pleasure at hearing an account given to this Society of work which Dr. Bracher had carried out over a long period of years, and which had been followed in Bristol with great interest. He drew attention to the fact that reaction took place to the same region of the spectrum in organisms so diverse as *Euglena*, *Pilobolus*, and *Avena*. He remarked that the rhythmical movements of *Euglena* showed features in common with such movements exhibited by flowers and leaves.

Dr. M. A. Pocock said that she had listened to Dr. Bracher's account of her work on *Euglena limosa* with great interest. It would be interesting if similar experiments on the light reactions of some of the organisms with which she herself had worked could be carried out.

Mr. D. J. SCOURFIELD asked if Dr. Bracher could say how *Euglena limosa* effected its periodical movements in and out of the mud, seeing that it had no flagellum. Were they brought about by the ordinary peristaltic-like alterations of shape common to most Euglenae? He said he had once seen the bottom of a small shallow pond carpeted green with another species of *Euglena*, probably *E. mutabilis*, which also was without a flagellum, but he had not made any observations whether this organism ever disappeared into the mud. He

thought Dr. Bracher's observations on *E. limosa* were most interesting and valuable.

The PRESIDENT also spoke.

Dr. BRACHER, in answer to Dr. Pocock, said that some experiments had been carried out on aquatic organisms and similar results had been obtained, e.g. those of Brooker Klugh. In answer to Mr. Scourfield, Dr. Bracher stated that *Euglena limosa* effects amoeboid movements. Usually the anterior end is protruded first as if to determine the direction of movement. The bulk of the cell then assumes a globular shape and, lastly, the posterior is drawn forward.

Plants used in the Balkan Peninsula in place of tea.

By Dr. W. B. TURRILL, F.L.S.

A CONSIDERABLE number of native plants are used by the inhabitants of the different countries of the Balkan Peninsula in the form of infusions with boiling water. It is not possible to draw a sharp line between such infusions as are considered only stimulating or refreshing, and those which are additionally valued medicinally, but the exhibit was limited essentially to plants, native to the Balkan Peninsula, whose aqueous infusions are used as hot beverages, much as tea is in this country.

The most satisfactory way of obtaining infusions from the 'tea' plants exhibited is to boil them with water for at least ten minutes, to obtain a strong solution, and to dilute to the required strength with hot water. The liquid is most pleasant without the addition of milk or sugar. *Salvia* and *Origanum* can be treated with boiling water in a tea-pot, but the other genera do not yield their full flavour in this way. It is notoriously difficult to describe odours and flavours. This is partly owing to the lack of standardized terms, and partly to personal idiosyncrasies of smell and taste. Anything said under this heading must, therefore, be understood as subjective.

No references to hot infusion beverages have been traced in classical Greek or Latin literature. On the other hand, there are many, but very scattered, references in more recent literature to this use of plants.

Vernacular names are applied to some of the tea-making plants. The word 'tschai' is obviously derived, via the Slav languages, from the Chinese word which we now pronounce 'tea'. When in 1934, in a Russian skete on Athos, a request was made for 'tschai', China tea of the Russian brand was served, but in a Greek monastery a similar request for 'tschai' produced a not unpleasing infusion of the leaves and young shoots of *Salvia triloba*. The name Faskomilé or Faskomileea is also applied in Greece to sage teas, to the plants used to make them, and to the galls produced by several species.

In Thrace the same name is applied to Lime (*Tilia*) inflorescences used for tea-making. In Bulgaria *Sideritis scardica* is known as, and sold under the name of, 'Pirinski tschai' or 'Pirin tea'. In Albania this species and *S. Roeseri* are known as çaj malit (mountain tea) or 'çaj shqyptare' (Albanian tea).

One aspect of the economic exploitation of wild plants is very much the concern of the botanist. There is a danger that certain species may be very much reduced in number of individuals, if not exterminated, by wholesale collecting. While there is no need to worry about the gathering of lime inflorescences, there is no doubt that the extended commercial use of some of the species of *Sideritis* might lead to the extinction of botanically interesting plants, since those used are endemic to the Balkan Peninsula, and several of them, notably *S. euboica* and *S. syriaca*, are of decidedly limited distribution.

Specimens of the following were exhibited:—

Tilia tomentosa Moench. (*T. alba* W. & K., non Michx.; *T. argentea* Desf.).

Four species of lime are accepted for the Balkan Peninsular flora and probably all of these are used locally for tea-making. The favourite species for this purpose, however, is *T. tomentosa* Moench, which occurs in all the districts except two (Crete and Istria). It is very distinct among the limes of S.E. Europe, not only by the leaves having an adpressed, finely stellate indumentum on their lower surfaces, whence the specific epithets, but also by the flower-structure. In every flower, inside the stamens, there are five petal-like staminodia, as they are termed, in the young flower closely pressed against the gynoecium. These occur in no other Balkan Peninsular species of *Tilia*, and, as a consequence, it is possible to identify with ease such material as is sold for lime-tea. This consists of the inflorescences, with open flowers and flower-buds, and the adnate bracts.

The infusion is of a rather pleasing yellow-brown colour, with a tinge of red and a slight reddish fluorescence. The flavour is 'soft', neither bitter nor strongly aromatic, and there is a distinctive, but not strong odour, which most nearly resembles that of open flowers of *Hamamelis mollis*. Lime-tea is, of course, well known throughout Central Europe, and an interesting account of it will be found in Hegi's 'Flora von Mittel Europa'.

Althaea pallida W. & K.

Including *Alcea*, to which section or subgenus *A. pallida* belongs, nine species of the genus occur in the Balkan Peninsula. *A. pallida* is known from all the districts, except Crete, the Rodepe Massif, Hercegovina, and S. Croatia.

For tea-making the open flowers, with their epicalyces, are used. The infusion is of a dirty green-purple—not at all attractive. It has a stronger flavour than *Tilia*, and is slightly acrid, with a faint odour of varnish.

Matricaria Chamomilla L.

The false chamomile is known to occur wild in all the districts of the Balkan Peninsula, except two (Rodope Massif and Hercegovina). Probably the 'tea' is most often made for medicinal purposes, but Heldreich notes that the Greek chamomile gives a specially pleasant aroma, that the infusion is scarcely bitter and is very pleasing to drink. These remarks can be confirmed for the material sold at Xanthi, Thrace.

Salvia triloba L. f.

Several of the thirty-one Balkan Peninsular species of *Salvia* are used locally for making 'sage-tea'. As a refreshing beverage *S. triloba* has the best reputation. This species is known from Crete, Greece, the Cyclades, Corfu, Athos Peninsula, Thrace, and Hercegovina. The young leaves and vegetative shoots or older leaves are used. The infusion is of a pale brownish colour with an olive-green tinge, and has a thin film of oil on the top when freshly made. It gives off a strong, somewhat mentholated odour, and has a very strong 'sage' flavour, which is followed by a 'biting' effect on the tongue.

Origanum hirtum Link.

This species has a wide distribution in most of the districts of the Balkan Peninsula. The infusion is of a dull greenish yellow with no obvious oil-film on the surface. The odour is that of very strong marjoram and there is a slightly pungent taste.

Sideritis.

This genus, with thirteen species in the flora of the Balkan Peninsula, provides the best and most characteristic 'teas', considered merely as beverages. *S. Roeseri* Boiss. & Heldr. is a native of Greece, Thessaly, Epirus, and Albania. It is very polymorphic, and the extreme variations, var. *lanceolata* Hal. from Epirus and south Macedonia and var. *attica* (Heldr.) Hal. from Greece, might well be taken for distinct species if the numerous intermediates were unknown. *S. syriaca* L. is, in spite of its unfortunate specific epithet, endemic to Crete. *S. euboea* Heldr. is known only from the island of Euboea (Mt. Dirphys and Xerovuni). *S. scardica* Griseb. is more widely distributed in Thessaly, Albania, N. Macedonia, and the Rodope Massif. *Sideritis scardica* is variously known as Albanian tea, mountain tea, and Pirin tea. It is sold in

shops in Sofia, in packets with printed labels—very similar to packets of tea one can buy in Britain. It was figured and described in Hooker's 'Icones Plantarum', t. 3157 (1932). The infusion has a yellowish brown colour with a very faint tinge of green. The odour is not distinctive—rather like a heap of lawn-cuttings at the beginning of their fermentation. The flavour is something like maté (*Ilex paraguayensis*) with a pinch of 'herbs' added.

Dr. A. B. RENDLE, commenting on the use of regional substitutes for tea, suggested that a climatic factor might be involved. The South American maté found little favour here, and travellers returning from Brazil, enthusiastic in its praise, lost their appreciation of the beverage when at home.

Mr. J. RAMSBOTTOM said that it was interesting to see such an extensive series of 'tea' plants, and to have precise information about their use. While he himself was in Macedonia he had not come across the use of such plants, but conditions at that time were not always ideal for enquiring closely into native customs. During the hot summer there everyone must be struck with the very large proportion of aromatic plants, and it would seem a logical step to make infusions of these for various purposes, one of which might be as a substitute for tea—a beverage too expensive for the ordinary Macedonian.

Professor MACGREGOR SKENE said that it would be of interest to know whether the various infusions described by Dr. Turrill, and especially those on general sale, were drunk as beverages, or used only on social occasions or for medicinal purposes.

Dr. HUGH SCOTT, while listening to Dr. Turrill, had been reflecting on a possible parallel between the use of these infusions by the Balkan peoples, and the custom of earlier generations of our own country-folk, who made 'tea' with hoarhound, tansy, dandelion, and other herbs. But he imagined that in Britain the use of these infusions was purely medicinal, whereas in the Balkans some of the 'teas' also serve as beverages.

Dr. T. A. SPRAGUE also spoke.

In reply to questions, Dr. TURRILL stated that all the above infusions were used as ordinary beverages, but that probably they were often considered also to have some medicinal qualities.

Grasshoppers (Orthoptera, Acridiidae) collected by Capt. F. Kingdon Ward in Tibet in 1935. [Abstract.] By Dr. B. P. UVAROV.

THE object of my communication is to draw attention to a case of discontinuous distribution in Grasshoppers (Orthoptera, Acridiidae), which has arisen in working out the results of

Captain F. Kingdon Ward's 1935 expedition to southern Tibet. Two of the species brought home proved to be undescribed members of the genus *Mekongia* Uv. This genus, now containing three species, and *Yunnaties* Uv. with one species, belong to the group *Sphenarii*, of the subfamily *Pyrgomorphinae*. This group includes two genera in tropical Mexico and northern South America, and one genus (with three species) known from a small isolated area of tropical rain-forest on Mt. Chirinda in Southern Rhodesia. The discontinuous occurrence of closely allied forms in S.E. Asia, on one hand, and in tropical America, on the other, is a well-known biogeographical phenomenon, which is accounted for either by admitting a direct land-connection in the past across the Pacific (cf. J. W. Gregory), or by a former spread of a tropical flora and fauna farther north in both continents, with a connection through the continent of Behringia, the existence of which in the Tertiary is very probable. In the latter case, the tropical flora and fauna would have had to retreat southwards during the glaciation, and two discontinuous refuge areas would be established. Neither of these theories, however, explains the occurrence of allied forms in Tropical Africa.

Dr. FRITZ VAN EMDEN mentioned some other cases of discontinuous distribution in beetles in S.E. Asia and the northern part of the neotropical region. In some circum-tropical genera such as *Sandalus* and *Callirrhapis* the neotropical species are nearest to forms of the Indian subregion (Emden, 1929, 3. Wanderversammlung Deutscher Entomologen Giessen, p. 116); the neotropical genus *Celadonia* (Uruguay to neotropical Mexico) is very closely related to *Simianellus* (British India to Formosa, Philippines, Celebes, Moluccas); each of the small Carabid subtribes *Cratocerina* and *Lebidiina* is represented by only one genus extending from Brasil to neotropical Mexico and by another genus distributed from Burma or Kumaon to Siam, Japan, the Sunda Isles, etc.; and the genus *Ancus* occurs only in the Amazons and Siam. Common features of distribution to these six groups of species are their occurrence on the Burmese peninsula, and the fact that in America the Mexican highlands are not reached, or (*Sandalus* and *Callirrhapis*) only by more deviating forms. This seems to exclude any explanation by assuming an earlier, wider distribution along the Behring Sea. Of the many existing theories, indeed, only v. Ihering's 'Archigalenis Land-bridge' (1911, Neues Jahrb. Min. Geol. Pal. xxxii, Beilage-Bd. p. 134), based on palaeontological and zoogeographical studies, would account for just this type of distribution, which often includes the Antilles (*Gallerucidia*),

though this land-bridge looks rather fantastic when drawn on the map.

Sir EDWARD POULTON said that he believed that the interesting examples of discontinuous distribution of grasshoppers brought forward by Dr. Uvarov were to be best explained by the existing of former continuity of the great continental land-masses with the northern circumpolar belt, together with the disappearance of certain species from parts of the areas formerly occupied.

Mr. M. A. C. HINTON called attention to the distribution of the Dwarf Squirrels described by Thomas (Proc. Zool. Soc. 1914, p. 415). The group contained three very closely allied genera: *Nannosciurus* Trouessart, inhabiting Malaya, *Myosciurus* Thomas, inhabiting West Africa, and *Sciurillus* Thomas, first recorded by J. E. Gray (1845) from 'Brazil' (two poor specimens in the British Museum), and then by Thomas (1914), who determined the affinities of this animal, from British Guiana. Mr. Hinton thought that neither 'land-bridges' nor glacial periods were necessary to explain such remarkably discontinuous distributions; the creatures concerned were very old forms of northern origin, which had spread southwards through the continents, become extinct over most of the area previously inhabited, and were now found only in these isolated outposts.

Mr. H. W. PUGSLEY suggested that the occurrence of the two known species of Tapir in the Malay Peninsula and South America was a similar case of discontinuous distribution.

Dr. A. B. RENDLE said that the remarkably discontinuous distribution recorded by Dr. Uvarov could be matched among plants. He recalled a genus of Ulmaceae (*Holoptelea*), previously known by a single species from India, Ceylon, and Cochin-China, which he had recorded from Togo-land, in West Africa.

Mr. J. RAMSBOTTOM said that not only in species, but also in customs, could the same type of discontinuous distribution be recognized. He instanced the growing of *Volvaria*, first described by Rumphius, but only recently recorded as being common to the Philippines, Java, Madagascar, and West Africa.

Mr. I. H. BURKILL also spoke.

In replying to speakers, Dr. B. P. UVAROV thanked them for supplying some interesting parallel cases of discontinuous distribution. They suggest that the isolation of closely allied forms in S.E. Asia, tropical America, and tropical Africa is observed in various groups of plants and animals. There must be some general reasons for this type of discontinuity, but they are not yet clear, and further facts must be accumulated to elucidate this problem.

The following papers were read in title :—

‘Further notes on the genera *Fumaria* and *Rupicapnos*. IV.’ By H. W. PUGSLEY, B.A., F.L.S.

‘Studies in the Capparidaceae.—1. The life-history of *Cleome Chelidonii* Linn. f.’ By T. S. RAGHAVAN, M.A., F.L.S.

‘Observations on *Himantalia lorea* (L.) Lyngb.’ By DOROTHY C. GIBB, B.Sc., Ph.D. (Communicated by Professor J. R. MATTHEWS, M.A., F.L.S.)

4 FEBRUARY 1937

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 11 January 1937, having been circulated, were taken as read and confirmed.

The following Loyal Address, with relevant correspondence, was read :—

PRIVY PURSE OFFICE,
Buckingham Palace, S.W.

Memorandum.

The Keeper of the Privy Purse is commanded by The King to state that His Majesty is pleased to intimate to those Societies and Institutions which were recently granted Patronage by King Edward VIII, that they may continue to show the Sovereign as their Patron during the present Reign, unless otherwise notified.

14th December, 1936.

To The King's Most Excellent Majesty

THE HUMBLE ADDRESS OF THE PRESIDENT,
COUNCIL, AND FELLOWS OF THE LINNEAN
SOCIETY OF LONDON

May it please your Majesty,

The Fellows of The Linnean Society of London wish to express their loyalty and their very deep devotion to your Majesty's Person, and pray that your Majesty's Reign may be long and distinguished.

The Society is deeply appreciative of your Majesty's gracious consent to continue the practice of your Predecessors by becoming Patron of the Society.

On behalf of the Council and Fellows of The Linnean Society of London,

W. T. CALMAN,
President.
h 2

Fourteenth January 1937.

THE HOME SECRETARY,
22nd January, 1937.

SIR,

I have had the honour to lay before The King the Loyal Address of the Linnean Society of London on the occasion of His Majesty's Accession to the Throne, and I have been commanded by The King to convey to you, as President of the Society, His Majesty's deep appreciation of the sentiments of loyalty and devotion to which it gives expression.

I am,

Sir,

Your obedient Servant,

JOHN SIMON.

The President,
The Linnean Society of London.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Charles Kirke Swann ; for the first time, in favour of Herbert Kenneth Airy Shaw.

For this meeting a series of exhibits had been arranged, and, after some of the exhibitors had made brief statements, the Meeting adjourned to the Library. The following exhibits were shown :—

A newly discovered picture of a Dodo.

By N. B. KINNEAR, F.L.S.

THERE were two species of the Dodo, the Grey Dodo, *Raphus (Didus) cucullatus*, found in Mauritius, and the White Dodo, *Raphus (Didus) solitarius*, inhabiting Reunion. The latter species was first mentioned in 1625, and became extinct between 1735 and 1801. One was brought alive to Amsterdam in 1670, and between 1735 and 1746 another was alive in France.

The present picture is by Pieter Holsteyn (1580–1662), and was recently acquired by the British Museum from an Amsterdam dealer, who said it was in a collection of paintings of different birds, all by Holsteyn. This painting is not mentioned by Professor Oudemans in his important paper, 'Dodo-Studien, Naar aanleiding van de vondst van een gevelsteen met Dodo-beeld van 1561 te Vere' (Verhand. d. K. Akad. Wetensch. Amsterdam (Tweede-Sectie), Deel xix, no. 4). He, however, records two other pictures of the same bird by

Holsteyn—one in Haarlem and the other in Amsterdam, both painted about 1638. These are reproduced in his paper, and both differ slightly from the new picture.

Later Pieter Witthos, the well-known painter of birds and landscapes, also painted a picture of the White Dodo about 1670, which is now in Lord Rothschild's collection.

Scale model of the Whale Shark (*Rhineodon typus*).

By J. R. NORMAN, F.L.S.

THE model exhibited (scale 1"—1') was prepared at the British Museum (Natural History) to serve as a basis for the life-size model of a 32-foot specimen now mounted in the Fish Gallery. It was based upon measurements, photographs, and sketches of a specimen caught off the coast of Florida.

The Whale Shark is a large pelagic shark, growing to a length of 50 feet or more, with a world-wide distribution in tropical seas. It is a sluggish inoffensive shark, and, like the Basking Shark (*Cetorhinus maximus*) of temperate seas, feeds upon planktonic organisms which are strained from the water by means of the long closely-set gill-rakers. The mouth is broad and placed at the end of the blunt head, and the jaws are armed only with rasp-like bands of minute teeth. The gill-openings are very wide. The ground-colour in life has been described as mouse-grey, with numerous spots and vertical streaks of yellowish white.

A series of Sea Anemones. By Captain A. K. TOTTON.

A SERIES of Sea Anemones from the Department of Zoology, British Museum (Natural History), explaining the variety of habits assumed in the group. The most interesting were some small brackish-water forms discovered by Miss G. F. Selwood in the mud of ponds in the Isle of Wight, and described by Prof. T. A. Stephenson in 1935 as a new species, *Nematostella vectensis*. This anemone is remarkable for the fact that swimming about actively in its coelenteron are to be found motile batteries of nematocysts, which recall to mind the rounded but stalked grape-like clusters of nematocysts found on the mesenteries of some of the Ceriantharia.

Other forms exhibited included a vertical section of one of the floating Minyads, showing the chitinous float in its base; a vertical section of the deep-sea form *Actinoscyphia aurelia*, remarkable for its thick mesogloea layer that resembles that of the umbrella of a strongly built jelly-fish; and a species of the swimming *Bolocerooides*, that has invaded the Suez Canal from the Mediterranean. Another deep-water anemone, *Actinauge richardi*, shown in vertical section, demonstrated how the base digs down into the mud, encircles a large quantity

of it, and so anchors itself to the soft bottom. Some specimens of the many-mouthed *Ricordea florida* were exhibited. Carlgren has suggested that such 'skeletonless corals' should be grouped apart from both Actiniaria and Madreporaria as a co-ordinate group Corallimorpharia. A large specimen of *Bolocera tuediae* and diagrams explained autotomy of the tentacles in this anemone.

A mounted spider's web. By R. J. WHITTICK.

[No abstract received.]

Ampullaria sp. (living) from S. America.

By G. I. CRAWFORD.

THE Ampullariidae are a family of fresh-water snails, which possess a lung and a gill. They inhabit slow-flowing rivers, often in places which dry off in summer: in this event they are able to travel overland, and if necessary spend the dry season buried in the ground. Most of the New World species belong to the genus *Ampullaria*, and possess a long siphon, by means of which they can respire air when still in the water. In the largest Old World genus, *Pila*, the siphon is very short.

Type-slides of Diatoms. By R. ROSS, Department of Botany, British Museum (Natural History).

THREE type-slides of Diatoms from the British Museum Collection were exhibited. The name type-slide is rather unfortunate, as the specimens on these slides are not nomenclatural types, the slides being only arrangements of typical specimens from one locality or of one genus. As well as having a certain scientific value, they are remarkable demonstrations of the skill of their preparers. Each Diatom valve has to be picked up separately and placed in position on the cover-glass, and as there are up to 350 specimens on a slide this involves much patient and delicate work.

Three classes of type-slides exist, an example of each of which was shown. In the first the Diatoms are arranged in a symmetrical pattern on the slide, and such are of little scientific value. The interest of the one shown was that it had been prepared by Laurence Hardman at the age of 82. In the next slide the Diatoms are arranged in rows on the slide and individual specimens can thus be referred to. Such slides, especially when named by an authority, have considerable value in systematic work. The third represented the most advanced technique, as beneath each specimen the

name had been printed by a photographic process. This had been prepared by I. D. Möller of Wedel in Holstein, who made a speciality of such slides.

Antarctic Lichens. By I. MACKENZIE LAMB, F.L.S.

THERE exists at present a great disparity between the relative amounts of lichenological data available concerning the Arctic and the Antarctic regions. While the lichens of the Arctic have been intensively collected and worked through critically and as a whole, Antarctic collections are represented at present only by, so to speak, random samples taken in the few localities where time and opportunity favoured. Thus not only is the material of a somewhat scattered and fragmentary nature, but it has been examined by several different lichenologists, each of whom worked more or less on a basis of his own construction, paying scant attention to species described from the same regions by previous workers. Hence, in order to reduce Antarctic lichenology to an exact science, it is now necessary to revise critically all the species previously described from these regions, and it may be expected that many species will be 'telescoped' in the process.

It is a well-known fact that the boreal and austral circum-polar lichen-floras are fairly closely related, although in the main part different from those of the lower latitudes. The hypothesis usually put forward in explanation of this fact is that the ancient polar floras were at one period continuous, and, with a general decrease in the severity of the climate, followed the retreating ice and snow into the Arctic and Antarctic regions.

Among a number of interesting features presented by these Antarctic lichens one is of particular interest: the tendency to assume an upright, or fruticulose, habit. A number of genera, usually strictly crustaceous, tend to develop a more or less upgrowing habit in the Antarctic regions.

(a) Crocuses collected by Mr. Edward K. Balls in Asia Minor, 1933-4-5; (b) *Crocus* species in season. By Dr. E. J. COLLINS, F.L.S.

(a) A group of *Crocus* forms collected by Mr. Edward K. Balls in the N.E. corner of Asia Minor was shown. Since flowering normally occurs in the early autumn, August and September, plants were exhibited as mounted specimens with an axis dissected to show the structural relationship of the sheathing leaves, foliage leaves, involucrel and floral bracts. The specimen labelled E.K.B. 1966, *Crocus Scharojani*, was collected at Haldizan, 11. 8. 34, at 8,000 feet; that labelled E.K.B. 2029, *C. vallicola*, at Hamsekeui, near Trebizond, 12. 9. 34, at 6,000 feet. Two other forms labelled E.K.B.

2034 and 2042 would appear to correspond with Maw's descriptions of *C. vallicola* var. *Suwarrovianus* and *C. vallicola* var. *lilacinus* respectively, but since little is known of these varietal forms, and there would appear to be differences of major importance, judgment as to their relationship with the type *C. vallicola*, of which there is no doubt, is held over.

(b) Of the thirty forms shown as specimens from the open ground the most noteworthy were:—*C.c. Imperati*, *versicolor*, *minimus*, *corsicus*, *etruscus*, *banaticus*, *Sieberi*, *reticulatus*, *dalmaticus*, *ancyrensis*, *susianus*, *gargaricus*, *Korolkowii*, *vitellinus* and its variety *graveolens*, distinguishable only by the scent, *maesiacus*, *Olivieri*, *Balansae*, *cyprius*, *Fleischeri*, *Leichtlini*, *biflorus*, and *chrysanthus*.

A pamphlet and also views of places connected with the childhood of Linnaeus. By Miss M. L. GREEN, F.L.S.

THE pamphlet is entitled 'Råshult och Stenbrohult: Där Linné föddes och växte upp' ('Råshult and Stenbrohult, where Linnaeus was born and where he grew up'). It gives a popular account of the birthplace of Linnaeus (Råshult). The old building was restored in 1931-3, when some additions were taken away, the house now appearing as it did at the end of the eighteenth century. According to tradition Linnaeus was born in this house, but no one knows how it looked at that time. His father was made Rector of the parish of Stenbrohult, and the family moved there when Carl was two years of age.

The pamphlet is illustrated with photographs and a plan of Stenbrohult comparing the modern parish with that at the time of Linnaeus. The exhibit included also the following six photographs: (1) Råshult. The birthplace of Linnaeus; (2) Råshult, showing obelisk with portrait medallion of Linnaeus by K. C. Qvarnstrom, 1886; (3) Junipers at Råshult; (4) Stone erected in 1935 when the 'Home of Linnaeus' was opened to the public. On the stone are the signatures of the Crown Prince and Crown Princess of Sweden; (5) The church at Stenbrohult; (6) The vicarage of Stenbrohult with one of the old Linnaean lime trees.

Miss Green is indebted for this exhibit to Miss Ester Björklund, Venersborg, Sweden.

The effect of Neon light on Begonias. By Sir ARTHUR W. HILL, K.C.M.G., F.R.S., F.L.S.

EXPERIMENTS have been carried out at the Royal Botanic Gardens, Kew, with the help of the Government Chemist and H.M. Office of Works, to attempt to overcome the damage caused by London fog—especially to flowers of Orchids and

Begonias in the greenhouses. Sulphur dioxide has proved to be the harmful gas in a fog, and by means of a special apparatus to produce SO_2 it has been found that, under humid conditions, a concentration of 0.23 parts per million of sulphur-dioxide for some hours will cause the complete fall of the leaves from shoots of *Begonia fuchsioides*.

As it was thought that the reduction of daylight during dull and foggy days might also have an injurious effect on the flowers, plants of Begonias (‘Gloire de Lorraine’ varr.), Calanthes, Cinerarias, &c., have been grown under Neon light to supplement the normal daylight. On dark and foggy days the Neon light has been kept burning for twelve hours, but on bright days for only such time as to expose the plants to twelve light-hours. Striking results have been obtained. The lighted plant of the *Cineraria* came into flower in January, while the one exposed to ordinary winter daylight has not yet opened a bud. The Begonias have not only retained all their opened flowers throughout December and January, but the individual flowers are larger and more intense in colour. On an average of some thirty-seven flowers on different plants of *Begonia* (‘Mrs. Lionel de Rothschild’) grown under normal conditions, the flowers measured 3.2 cm. in diameter, while those illuminated by Neon light were on the average 3.8 cm. in diameter, some being as much as 4.3 cm. across. The effect on the ‘Turnford Hall’ variety was equally marked, those exposed to normal daylight had flowers averaging 3.7 cm. in diameter, while those under the Neon light averaged 4.1 cm. in diameter—the largest being 5.1 cm. against 4.2 the largest in ordinary daylight.

Types of Asiatic Gentians.

By Mr. C. V. B. MARQUAND, F.L.S.

EVEN in the restricted sense of *Eugentiana* Kusnéz. (excluding *Gentianella*) the genus *Gentiana* exhibits a wide range of forms in Asia. In China alone 184 species are known. These are distributed in nine Sections of numerous Series. Five microscope slides of seeds and a selection of sixteen herbarium specimens covering a wide range of habit were shown. *Gentiana pluviarum* W. W. Smith, from Sikkim, has the smallest flowers known in the genus (2.5 mm. long), while *G. Heleni* Marquand, from Yunnan, has flowers up to 7 cm. long, recalling those of a *Convolvulus*. The range in seed-characters is equally wide and has been employed in classification, including those surrounded by a broad membranous wing as in Sect. *Dipterospermum*, triquetrous seeds in Sect. *Tripterospermum*, and smooth glabrous apterous seeds in Sect. *Chondrophylla*, while in other species belonging to Sect. *Frigida* they are

also apterous but covered by a honeycomb-like membrane. The genus is interesting in its meristic variation. Though pentamery is preponderant, there is one subseries comprising a small number of species whose flowers are always tetramerous, while in another series of the same section the foliage leaves are verticillate and the flowers hexamerous, heptamerous, or octomerous. In all other species the leaves are in pairs and the number of corolla-lobes is never greater than five. There is a distinct correlation between the number of corolla-lobes and the number of leaves in the whorls, but the number is not precisely fixed for each species. A most remarkable instance of meristic fluctuation is to be found in *Gentiana macrophylla* Pall. (Sect. *Aptera*), which is normally pentamerous, but sometimes has both tetramerous and pentamerous flowers in the same inflorescence.

New and rediscovered Mexican plants.

By A. A. BULLOCK, Royal Botanic Gardens, Kew.

A COLLECTION of herbarium specimens of Central Mexican plants, now approaching 10,000 numbers, made by Mr. G. B. Hinton, has been presented by him to the Kew Herbarium. A selection of twenty-four sheets of the more interesting plants was exhibited. These included material of a recently described genus of Rubiaceæ, *Hintonia* Bullock (Hook. Ic. Pl. t. 3295); *Sickingia mexicana* Bullock (t. 3321), a new species of a genus previously unrecorded from Mexico; *Cuphea Hintoni* Bullock (t. 3294) remarkable for its filiform disc partly adnate to the spur of the calyx; and *Bouvardia capitata* Bullock (t. 3296), unique in the genus by its capitate inflorescences.

Numerous species described by A. P. de Candolle in his 'Prodromus' from drawings of Mocino and Sessé's collection have long been problematical. Several of these have been rediscovered by Mr. Hinton, e.g. *Trixis decurrens* DC., which, although described and figured by Hernandez, Thesaurus 414 (1651), and subsequently figured by Mocino and Sessé, remained obscure until Mr. Hinton's material came to hand. *Gentiana salpinx* Griseb. (t. 3299), a remarkable red-flowered gentian, with stems up to 1 metre in height, was previously known only from the type-material collected by Ehrenberg over one hundred years ago; and *Rondeletia Jurgensenii* (t. 3322) had not been collected again since its discovery by Jurgensen towards the middle of the nineteenth century.

Amoreuxia Schiedeana (Cham. & Schlecht.) Planch., one of the Cochlospermaceæ, was illustrated by flowering and fruiting material, and a drawing of the seeds, which were

previously unknown. Their discovery confirms the treatment adopted in Sprague's revision of the genus (Kew Bull. 1922, p. 97, pl. 1), in which the Colombian material assigned by Planchon to *A. Schiedeana* was segregated as a new species.

Two growth-forms of *Weldenia candida* Schult. f., which have been regarded by horticulturists as distinct species, were exhibited. Among other interesting plants was a shrubby or almost arborescent new species of *Senecio* with persistent woolly bud-scales subtending the inflorescence.

South African 'Everlastings'.

By Dr. J. HUTCHINSON, V.-P.L.S.

THE South African flora is noted for its beautiful everlasting flowers. A collection has recently been acquired for the Museums of Economic Botany at Kew, and a selection was placed on exhibition at the meeting. These included the following Compositæ:—*Helichrysum argenteum*, *H. fruticans*, *H. paniculatum*, *H. retortum*, *H. sesamoides*, *H. vestitum*; *Helipterum eximium* (Strawberry Everlasting); *Phaenocoma prolifera*; *Lanaria lanata* (Haemodoraceae), and *Leucadendron argenteum* (Proteaceae). The specimens shown were presented to Kew by Dr. H. G. Fourcade, Witte Els Bosch, Dr. J. Muir, Riversdale, and Prof. R. H. Compton, Kirstenbosch.

A rediscovered fragment of the herbarium of Johan Anders Murray (1740–1791). By S. SAVAGE, F.L.S.

IN searching for a small collection of plants asked for by a Fellow of the Society, I came upon 167 herbarium sheets that were not marked in any way to show to whose herbarium they had originally belonged. The handwriting on these sheets, although decidedly of the Linnaean period, was unknown to me, but after reading carefully all the inscriptions I have been able to identify it as that of the Swede, Johan Anders Murray, the pupil of Linnaeus who became professor of medicine at Göttingen University in 1764. During a visit to Linnæus in 1772 he was allowed to borrow an interleaved annotated copy of the 'Systema Naturæ', and in 1774 published the 13th edition of Linnaeus's 'Systema vegetabilium', followed by the 14th edition in 1784.

The clue to the original ownership of these plants was found in the inscription to *Lychnis coccinea*; which is dated 14 July 1785, and in which the plant is stated to have not been included in the 14th edition of the 'Systema vegetabilium'. A reference to Murray's letters to Linnaeus showed at once, from the same handwritings, that these plants had once formed part of Murray's herbarium.

About the year 1818, 'The Herbarium of the late Professor Murray of Göttingen' was presented to the Linnean Society by George Hibbert, F.L.S. On 10 November 1863, when the Society sold the bulk of its Museum, item no. 242 in Stevens's sale catalogue was 'Herbarium of the late Prof. Murray, of Göttingen, editor of the 13th and 14th edition of the "Systema Vegetabilum", the specimens named and mostly glued down, 15 bundles'. One can only conclude that the 16th bundle is the collection now recovered.

The plants in this collection are partly loose and partly stuck down. A good many of the loose ones appear to have been collected in Holland; one is stated to have been received from Haller; and four came from a gardener named Kase-maker, of Copenhagen, in 1772.

Eleven specimens were received from the garden of Madame Hester Hooft, widow of George Clifford*. These have an interest as coming in all probability from Hartecamp, where Linnaeus worked during the years 1735-8. Among the glued down specimens are some from Göttingen University garden (marked H. G.), others from the herbaria of Büttner and of Willich, and a few from 'Hort. Harbecc.'

Concerning the present ownership of the bulk of Murray's herbarium, the only reference I have been able to find is one in de Candolle's 'Phytographie', 1880, p. 436, where he notes that this Society sold it and queries whether Martius had not acquired it.

Linnaeus's receipt for making the glue used for his herbarium specimens. By S. SAVAGE, F.L.S.

I FOUND this receipt written on the interleaf at p. 7 in Linnaeus's own copy of his 'Philosophia botanica'. The following is an attempted translation of the receipt:—

9. felle bœuf. 9. felle de. 3j. + forte. 3j. macer. p. rochen, Δ lento liquaf. al.
 uncto, et refrigerat, ab igne dte.
 Aloës hepaticæ 3℔. ½ conservat. 3j. m. itere penicillo, p. press.

9. Fish Glue. Take fish glue 1 oz., very strong vinegar 6 oz., soak over night, melt over a slow fire; after removal from the fire in order to cool it, add Aloës hepaticæ, ($\frac{1}{2}$ drachm), pounded cloves 1 scruple, (? mixed together). Spread with a brush; (put the sheet) in the press.

* On the titlepage of one of his copies of 'Hortus Cliffortianus', Linnaeus has written *obit* 1760 *Maji*. 20. under Clifford's name.

Not all (plants) should be glued in the middle [of the sheets] (Some should be) arranged at the sides. I approve (placing the plants) above, below, &c.

It is well known that Linnaeus used isinglass for sticking down herbarium specimens, but so far as I am aware the above detailed receipt has remained unpublished. In the Linnaean thesis, 'Materia medica in regno animali', 1750, the only fish mentioned from which glue was produced is *Acipenser*, the sturgeon. The 'Aloës hepaticae' in the receipt refers to the resinous gum of *Aloë perfoliata* var. *vera*, mentioned in Linnaeus's 'Materia medica', p. 53. One would suppose that the Aloës gum, vinegar and cloves were included to act partly as preservatives and preventatives of mites. I would add that a photograph of this receipt has been sent to Dr. A. H. Uggla, Uppsala, together with my transcript and translation; and I am indebted to him for a few valuable corrections and suggestions.

Coloured photographs of Tibetan plants.

By Captain GEORGE SHERRIFF.

THE flora of S.E. Tibet is noted for its richness in plants of horticultural interest. The flowers, as is usual with alpiners, have very fine colours and lend themselves admirably to colour-photography. The coloured transparencies of plants in their natural habitats which were exhibited included genera typical of that region, e.g. *Primulas*, *Meconopsis*, *Rhododendrons*, and *Gentians*. In each genus undescribed species were shown. The colour-rendering in most is very true; all the examples were processed in the film. The chief method used was the Lumière filmcolor: the films can be projected through a lantern.

Japanese toys made from wood of

Magnolia obovata. By W. T. STEARN, F.L.S.

ALTHOUGH in Europe *Magnolias* are esteemed purely as trees and shrubs for garden ornament, the Japanese *Magnolia obovata* Thunberg, non auct. plur. (*M. hypoleuca* Siebold & Zucc.), is of considerable value as a timber tree in its native country, and attains, according to Sargent, a height of as much as 100 feet in the forests of Hokkaido (Yezo), north Japan. The wood is light and easily worked without splintering. It is used for making toys and other small objects. The *Magnolia* wood occasionally used in this country for panelling is from the American 'Cucumber-tree' *Magnolia acuminata* Linn. The toys shown were formed of many small pieces of wood held together, without glue, by intricate jointing.

Book entitled 'Metamorphoses. Drawings left by Dr. Marianne van Herwerden', Haarlem, 1934. By Miss P. M. TAYLOR, F.L.S.

THIS small book shows many examples of those amusing flights of imagination which everyone has experienced at some time or other when faced with scientific drawings.

Dr. Marianne van Herwerden was a well-known Dutch cytologist and geneticist. 'It was only in the later years of her life that she took up this playing with lines and forms. As a rule, she made these drawings late in the evening after a day of strenuous brain-work. Then she gave her sense of humour and exquisite wit free scope, and then the figures out of scientific works reappeared in new shape.' Many of the original sources have been matched; some of the others possibly were not based on published drawings.

The PRESIDENT moved a vote of thanks to the exhibitors.

18 FEBRUARY 1937

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 4 February 1937, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted:—Robert John Aylwin Wallace Lever.

A certificate of recommendation of the following candidate for Fellowship was read:—For the second time, in favour of Herbert Kenneth Airy Shaw.

The President reported the deaths of Professor Max Weber and Professor Federico Raffaele, Foreign Members.

On behalf of Dr. T. A. SPRAGUE, the Botanical Secretary exhibited a specimen of *Ulex europaeus* from Dorset, showing foliage characteristic of seedlings, due to the plant having been cut down nearly to the base in the previous year.

Antarctic comatulids. By D. DILWYN JOHN.*Distribution and relationships.*

The number of known species of living crinoids is about 630. Of these about 80 are stalked ; the remaining 550 are comatulids which are unstalked as adults, though all pass through a stalked larval stage, the pentacrinoid stage. Many of these species have been described in the years of this century by Austin Hobart Clark, and he claims that the numbers now known make it wrong to speak of crinoids as a group on the verge of extinction.

In the last ten years the *Discovery* Committee's vessels have collected over 250 specimens of crinoids in the shallower waters of the Antarctic. The number of species previously known from the area was ten, of which two are stalked and eight are comatulids. The *Discovery* collection is entirely of unstalked forms. It includes seven new species and one species not previously recorded from the Antarctic : so that the number of Antarctic comatulids now known is 16. Nearly half of the *Discovery* specimens are of one species, *Promachocrinus kerguelensis*. The new species, which must remain unnamed here, will be described in a forthcoming *Discovery* Report.

The collection comes from two widely separated sectors of the Antarctic. By far the greater part is from the South American or Falkland sector ; a small part is from the Ross Sea in the New Zealand sector on the other side of the continent. Six of the seven new species, the species not previously recorded from the Antarctic, and two of the previously known species—nine in all—have been taken only from the South American sector. This may be because more collecting, and more careful collecting, has been done in this part than in any other. Four species are known from every quarter of the Antarctic but that which lies to the south of the Pacific, where no collecting has yet been done. They must surely be circumpolar.

Koehler (1912, p. 242), in his report on the Echinoderms of the Second French Antarctic Expedition, concludes that the Antarctic littoral fauna of Asteroids, Ophiuroids, and Echinoids is closely related to that of the extreme south of South America. Mortensen had previously (1910, p. 100) found that this was so of Echinoids ; Ekman has recently (1925, p. 187) expressed the opinion that it is true of Holothurians. It appears to be true also of the Crinoids.

The 16 comatulids known from the Antarctic are :—

Promachocrinus kerguelensis Carpenter.

Anthometra adriani (Bell).

Solanometra antarctica (Carpenter).

Florometra, two new species.
Eumorphometra concinna A. H. Clark.
Eumorphometra, a new species.
Isometra vivipara Mortensen.
Isometra, three new species.
Phrixometra longipinna (Carpenter).
Thaumatometra nutrix Mortensen.
Thaumatometra, a new species.
Notocrinus virilis Mortensen.
Notocrinus, a new species.

Specimens of all but *Solanometra antarctica* and *Eumorphometra concinna* were taken by the *Discovery* vessels.

The following are the reasons for believing that this fauna is related to that of South America :—

(1) Thirteen of the species are confined to the Antarctic. Three occur outside it too. *Isometra vivipara* is known from the Burdwood Bank, which is to the east of Cape Horn and outside the Antarctic, and from the Patagonian coast. *Phrixometra longipinna* was described from three specimens taken off the River Plate; the *Discovery* collection includes one from South Georgia. There are no other species of *Phrixometra*. *Thaumatometra nutrix* is known from two specimens, one from the Burdwood Bank, the other from the Antarctic. The places at which these three species occur outside the Antarctic are near or along the east coast of South America.

(2) Four species of *Isometra* are listed above, of which three are confined to the Antarctic, while the fourth (*I. vivipara*) is common to the Antarctic and the coast of Patagonia. Two other species of this genus are known; each was described from a single specimen taken by the *Challenger* off the coast of Uruguay.

(3) The genera *Promachocrinus*, *Anthometra*, *Solanometra*, and *Florometra* are closely related. The first three are monotypic and confined to the Antarctic. Of *Florometra* there are ten species other than the two new species from the Antarctic. Their distribution is from the Pacific coast of Japan to the Aleutian Islands and the Behring Sea, and southwards along the west coast of North and South America to Tierra del Fuego.

A part of the littoral crinoid fauna of the Antarctic is common with or related to that of the east coast of South America, a part is related to that of the west coast.

The genus *Notocrinus* is so distinct and specialized that a new family, the Notoocrinidae, was necessary to receive it. No recent forms but the two Antarctic species listed above are known. Of the genus *Thaumatometra* there are eleven other species besides the two known from the Antarctic

(one of which occurs on the Burdwood Bank as well). They are from rather deep water and from widely separated points : from near Japan, the Indian Ocean, the north Atlantic, the Behring Sea, from near New Zealand, and the Crozets. Mortensen was not entirely satisfied that his species (*T. nutrix*) belonged to this genus and I am not sure that the new species does.

There is one other species of *Eumorphometra* in addition to the two Antarctic forms. It is *E. hirsuta* (Carpenter) from Marion Island in the Kerguelen group. This is an area regarded by Regan (1914, p. 36) as an Antarctic faunal district. *Promachocrinus kerguelensis* occurs at Kerguelen and Heard Island. Koehler (1912, pp. 221-5) shows how close is the relationship between the littoral Asteroid, Ophiuroid, and Echinoid faunas of the Kerguelen district and the Magellan region of South America ; he lists fifteen species common to the two areas, and as large a number of species from each area of which closely related forms are found in the other. No crinoid common to the Magellan and Kerguelen regions is known.

Brood-protecting species.

Eight of the 16 Antarctic comatulids protect their broods. They include the three species (*Isometra vivipara*, *Phrixometra longipinna*, and *Thaumatometra nutrix*) which occur outside the Antarctic also. Only one other brood-protecting species, which has not yet been described as such, is known ; it is from southern Australia. The degree and the method of protection vary in the different species. In *Eumorphometra concinna* there is a large membranous brood-pouch lying alongside each ovary, i.e. along the third and a few of the succeeding segments of the genital pinnules of the females. Each contains embryos in various stages of development, the most developed having the elements of skeletal plates within them and bands of cilia around them. They evidently pass on to a free-swimming stage before settling down into pentacrinoid larvae. There are similar pouches in *Phrixometra longipinna*.

Isometra vivipara and two of the new species of *Isometra* also protect the brood in pouches alongside the ovaries. In all three the hard parts of the segments of the genital pinnules are strongly expanded to arch over and protect the ovary and brood-pouch. A much smaller expansion takes place over the testes of the male ; it is so much smaller that, whereas in almost all comatulids males and females are indistinguishable from one another to the naked eye, in *Isometra* they may be recognized at a glance. A brood-pouch of *I. vivipara* may contain up to twenty-five embryos in all

stages of development leading up to that which possesses ciliated bands. The free-swimming stage appears to be short, for embryos settle in large numbers on the up-turned cirri of their mother and there develop into pentacrinoid larvae. The number of embryos is smaller in the other two species of *Isometra*.

In *Thaumatometra nutrix* there are brood-pouches alongside the ovaries. In the one female known they contain no developing embryos: they contain instead later stages, the pentacrinoid larvae, attached to the inner side of the pouch, but with the head and the greater part of the stalk protruding through the opening. In no brood-pouch are there more than two pentacrinoids. It is clear that the embryos never leave the brood-pouch and possible that they have no ciliated bands, for they would have no use for them (cf. *Notocrinus virilis* below). This is far greater, because far longer, care of the brood than in the species described before.

The genus *Notocrinus* is peculiar in that the gonads do not lie as in all other comatulids on the middle pinnules but in the axils between the pinnules and the arms, largely on the arms. The two known species protect their broods; there is a large brood chamber distal to each ovary. In those of the new species there may be up to thirty small embryos in all stages of development up to the free-swimming larva surrounded by five bands of cilia. The brood-pouches of *N. virilis* contain one to three very much larger embryos with no trace of ciliated bands. They cannot pass on to a free-swimming stage; where they develop into pentacrinoid larvae is not known.

Mortensen (1920) has given full accounts of the development of *Isometra vivipara*, *Notocrinus virilis*, and *Thaumatometra nutrix*. I am indebted to Dr. A. H. Clark for having sent me portions of *Eumorphometra concinna*.

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Sir SIDNEY HARMER remarked that he had seen Crinoids swimming across a tank in the Aquarium at Naples by means of graceful simultaneous movements of their arms. He

enquired whether Mr. John had had the opportunity of ascertaining whether Antarctic Crinoids behave in the same way.

Mr. R. H. BURNE recalled the fact that viviparity or the incubation of young was abnormally frequent among Antarctic Lamellibranchs.

Professor W. GARSTANG and the PRESIDENT also spoke.

Early larval development in the Euphausiacea. By F. C. FRASER, Department of Zoology, British Museum (Natural History).

THE interpretation of the early furcilia stages of development in the Euphausiacea has hitherto been dominated by the view that each variation of pleopod development encountered in any particular species represents a stage in the developmental history. Thus Brook and Hoyle (1888) describing the metamorphosis of British Euphausiidae state that in the furcilia of one species there are eleven moults, judging from the comparative development of the pleopods. The series starts with Stage I, a form having no pleopods; it proceeds by the successive addition of non-setose pleopods to Stage VI, which has five pairs of non-setose pleopods. Stages VII to XI are identified by the successive provision of setae on the pleopods till all five pairs are setose.

Lebour (1926 a) recognizes a succession of furcilia forms identifiable by the number and form of the pleopods, but in addition she points out that 'The pleopods develop in different ways in several different genera, of which the first three or four [forms] are the same, and the last two or three are the same, but in between there are different orders of development some of which appear to be characteristic of certain genera'. The paper later states that the distinctive stages nearly always seem to occur as though certain stages were dominant.

Macdonald (1927), dealing with *Meganyctiphanes norvegica*, distinguishes eleven furcilia stages by the number and form of the pleopods, and in an analysis of frequency discovered that two stages, namely IV and IX, were dominant.

Curtailed larval histories are known in several species, thus in *Nematoscelis microps*, according to Lebour (1926 b), 'The youngest stage found is presumably the second furcilia . . . having one pair of simple bud-like pleopods. . . . The next seen has one pair of pleopods setose and three pairs simple. It is striking that these stages together with the tenth (i.e. four pairs setose and one pair non-setose) seem to be dominant, as no intermediate stages were found whilst these were abundant'. With reference to *Euphausia krohnii* Lebour states: 'Sars describes the second and seventh furcilia having one

pair of simple pleopods and one pair setose and four pairs simple respectively. No stages between these two have been found. . . . The furcilia with all pleopods setose is presumably the last'. In *Thysanopoda aequalis* she states: 'The first furcilia, the earliest stage seen . . . has no pleopods. The next stage . . . is probably the third furcilia having two pairs of simple pleopods. Then apparently several stages are absent and the next seen . . . probably the seventh furcilia, has two pairs of setose pleopods and two pairs simple'. The following furcilia stage is that in which there are four pairs of setose pleopods and the last pair non-setose.

Rustad (1934) shows that in *Euphausia frigida* the furcilia stages V, XIII, and XIV of Lebour's pleopod diagram are the only ones found. Similarly, in *Thysanoessa macrura* and *Th. vivina* Rustad states that the furcilia stages I, VI, and XIV of Lebour's scheme were the ones found by him.

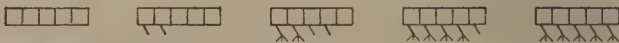
NEMATOSCELIS MICRIPS



EUPHAUSIA KROHNII



THYSANOPODA AEQUALIS



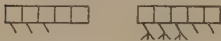
EUPHAUSIA FRIGIDA



THYSANOESSA VICINA AND MACRURA



MEGANICTIPHANES NORVEGICA (DOMINANT STAGES ONLY)



The dominant stages of *Meganyctiphanes norvegica* and the only early furcilia stages found in the other six species referred to are represented diagrammatically in the figure, in which the five divisions of each little rectangle represent the first five abdominal segments. The unbranched lines on the lower margins of the rectangles represent non-setose pleopods and the forked lines setose pleopods.

It was pointed out by me (Fraser, 1936) that in all the species mentioned the earlier dominant stage bears a direct relationship

to the later in that the less advanced becomes the more advanced by the provision of setae on the non-setose pleopods present in the earlier stage, and the addition of one or more pairs of pleopods until the full complement of five pairs is made up. Thus in *Nematoscelis*, for example, the one pair of simple pleopods gives rise to a form with one pair setose and three pairs simple, which in its turn produces a form with four pairs setose and one pair non-setose.

In addition to the species mentioned, further evidence of a succession of early furcilia stages in which non-setose pleopods become setose at the next ensuing moult is provided in papers by Frost (1935) and John (1936). Frost shows that in *Nematoscelis megalops* the pleopod succession is: two pairs non-setose—two pairs setose three pairs non-setose—all five pairs setose; and in *Stylocheiron longicorne* it is: no pleopods—one pair non-setose—one pair setose two pairs non-setose—three pairs setose two pairs non-setose—all five pairs setose. In the same way John states that in the species *E. vallentini* and *E. triacantha* the succession is: four pairs non-setose—four pairs setose, one pair non-setose—all five pairs setose; and in *E. longirostris* and *E. spinifera* it is: one pair non-setose—one pair setose, three pairs non-setose—four pairs setose, one pair non-setose—all five pairs setose.

In *Euphausia superba*, in the samples examined by me, fourteen different forms of furcilia were recognizable by the variation of the development of the pleopods. These forms, and the frequency of their occurrence expressed in the number of plankton stations at which they were found, are shown in the first and second columns of the following Table:—

	Number of stations at which the form was found.	Larvae from St. WS 527.	Frequency of larvae at stations where large numbers were found.
(1) No pleopods	1	8	8
(2) 2 pairs of simple pleopods	1	4	4
(3) 3 " " "	5	8	12
(4) 4 " " "	23	36	92
(5) 5 " " "	39	20	710
(6) 3 pairs of pleopods, 2 setose, 1 non-setose....	1	8	8
(7) 4 " " 1 " 3 "	1	4	4
(8) 4 " " 2 " 2 "	1	4	4
(9) 4 " " 3 " 1 "	1	4	4
(10) 4 " " all setose	1	0	—
(11) 5 " " 2 setose, 3 non-setose....	2	6	6
(12) 5 " " 3 " 2 "	2	32	32
(13) 5 " " 4 " 1 "	12	120	123
(14) 5 " " all setose, A & B forms .	45	242	428

Of the fourteen different sorts of furcilia seven occurred at one station only, and for six of them the station was the same, namely, St. WS 527. Furcilia with four or five pairs of non-setose pleopods and furcilia with four pairs setose and one pair non-setose or all five pairs setose are in greatest abundance—they are, in fact, the dominant stages. This evidence of dominance is supported by the results of frequency of occurrence of the different kinds of larvae at St. WS 527.

If the different forms of pleopod development encountered at this station be examined it will be seen that without retrogression in development either in the number of pleopods or in the formation of setae the larvae cannot moult successively into all the different forms found. For instance, those with four pairs of non-setose pleopods cannot moult into forms having three pairs of pleopods two pairs of which are setose without diminishing the number of pleopods. Or if the three pleopod form be considered less advanced than that having four pairs non-setose it cannot moult into the latter form without shedding the setae on the first two pairs of pleopods.

Practically every one of the *E. superba* larvae with non-setose pleopods had within the integument of these abdominal appendages the rudiments of setae, that is to say that at the next ensuing moult the non-setose limb would become setose and would not wait until further non-setose limbs were added before becoming setose. Thus one would expect to find, what actually happens, that the relative abundance of the non-setose larvae would be reflected in the setose section.

Finally, the frequency distribution of larvae at stations from which representative samples were examined, as shown in the last column of the Table, supports the view that the larvae moult from forms with non-setose pleopods directly into forms in which those non-setose pleopods are setose. It has been suggested by me, therefore, that in *E. superba* up to the point when five pairs of setose pleopods are present only two, instead of fourteen, stages actually exist, and that the infrequently occurring pleopod forms are simply variations of the two dominant ones. I suggest too that in the other species mentioned in this paper the forms recognized as dominant should be regarded as actual stages in the developmental history. Thus in *Nematoscelis microps*, for instance, the stages referred to as second, sixth, and tenth should be regarded as stages I, II, and III, and in *Meganyctiphanes norvegica* the dominant stages IV and IX should be called I and II. John (1936) has adopted this newer way of interpreting euphausian larval stages in his report on the southern species of the genus *Euphausia*.

With reference to *Meganyctiphanes*, Macdonald quoting Gurney (1924) states that 'among Crustacea, continuous

larval development is a primitive feature, whereas a marked metamorphosis is characteristic of more highly developed forms'. He draws attention to the dominance of certain furcilia forms as suggesting 'tentative steps in an evolutionary progress in the order Euphausiacea towards reduction in the number of larval stages. They also suggest that in those arthropods in which the life-history consists of a few pronounced stages these are to be regarded not as having evolved independently from a continuous life-history, but rather as survivors of a once greater number of successive stages'.

In the light of the evidence provided by *Euphausia superba* and the interpretation of known larval histories in relation to this I have stated: 'It is misleading to talk of a tentative reduction in the number of larval stages. This conception is based on the assumption that each variety of pleopod development found indicates a larval stage. It implies that as a primitive phase in the evolutionary history of this group the larvae went through this succession of numerous well-marked changes in form, which is of course contrary to the idea of continuous development. In primitive development one would expect to find no well-marked coincidence of ecdysis with a fixed degree of development. Metamorphosis, as already stated, is a characteristic of highly developed forms. The Euphausiacea should be regarded as coming somewhere between the two extremes, they are arthropods in which "continuous" development is giving way to metamorphosis—already well defined in the Nauplius, Metanauplius, and Calyptopis stages, less well defined in early furcilia by the presence of dominant forms, and still less intelligible in later development. This developing metamorphosis is not essentially a reduction in the number of successive stages, but is being brought about by the larvae tending to moult into forms showing a certain degree of development in preference to a lesser or a greater degree.

'Continuous development is not an altogether appropriate term to apply to the development of any arthropod, since the course of development is in all cases marked off into stages by the occurrence of ecdyses between which no marked change in form usually occurs. Where ecdyses are numerous and the morphological changes occurring at each are slight, the development is of the type to which the term "continuous" has been applied. Where ecdyses are reduced in number, while the total change to be achieved remains the same, the amount of change at each moult will obviously increase till it may reach a degree deserving the name "metamorphosis".'

'There is a further consideration to which attention may be drawn. In the more specialized forms with fewer ecdyses the position of each moult on the scale of development, and

therefore the changes occurring at each, becomes as it were standardized. In the more primitive cases with so-called "continuous" development the position of the moult may vary, and the changes at each are not always identical. The series of moults may, in fact, be regarded as a kind of "grid" superposed on the course of actually continuous development. In the more primitive cases this grid may still shift slightly backwards and forwards; in the more specialized cases the "grid" has become fixed and all individuals show the same changes at each moult.'

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The President and Professor W. Garstang contributed to the discussion; and Mr. Fraser replied.

Glimpses of the Ecology of North America and Jamaica.

By Dr. V. J. CHAPMAN, F.L.S.

IN the Michigan sand-dunes the drift-line flora is represented by *Cakile edentula* var. *lacustris*, a relic from the period when the Great Lakes were maritime. The sand-dunes form a belt up to two miles wide composed of parallel ridges with pannes in between. On the ridges a definite succession can be traced beginning with *Calamovilfa longifolia* and young *Populus*

deltoides. Older ridges bear a mature *Populus deltoides* community with numerous shrubs and creepers. In the third or fourth ridges the sand is stabilized, and there is a dense covering of herbs, creepers, shrubs, and trees. *Pinus Banksiana* occurs on these as a relic of the post-glacial vegetation. The oldest dunes are occupied by a *Quercus alba*—*Q. velutina* wood. The youngest pannes have seedlings of *Populus deltoides*, the distribution being controlled by the extent of the flood-water in the spring. Older pannes contain *Salix* spp., *Juncus balticus*, *Aster onerifolius*, and other species. If standing water is present a reed-vegetation (*Scirpus* spp., *Typha latifolia*) develops.

The Utah-Nevada desert forms the northern portion of the Sonoran-Nevadan desert. Clements has recently suggested that the Sonoran portion only is true desert, but there seems to be some doubt as to the validity of this concept. A few plants have migrated north from Mexico, there are a number of endemics and several species have invaded the area from the W., NW., and NE. Dominant species are *Sarcobatus vermiculatus*, *Obione confertifolia*, *Eurotia lanata*, *Artemisia spinescens*, *A. tridentata*, *Kochia vestita*, and *Atriplex polycarpa*. The waters of the Great Salt Lake have been receding in recent years—evaporation exceeds inflow—and the salinity has increased from 22 to 28 per cent. salt. In spite of this high concentration a number of species flourish. Salt marsh with *Distichlis spicata* and *Salicornia rubra* is formed, whilst *S. rubra*, *S. utahensis*, and *Allenrolfia occidentalis* form the dominant species on the salt flats.

The salt marshes of the Pacific Coast do not appear to alter between San Francisco and San Diego, and there are no changes with latitude such as are found on the eastern seaboard. A pure community of *Spartina leiantha* forms the lowest zone and also borders the creeks. It is followed by the main marsh plant *Salicornia ambigua*, which exists as a practically pure stand. The uppermost zone is occupied by *Spergularia Clevelandii* and *Frankenia grandifolia*.

The Arizona desert, which forms part of the Sonoran desert, differs from the Utah desert in the presence of numerous shrubs, of which *Larrea mexicana* is the dominant. There are numerous Mexican species including Cactaceae (*Opuntia* spp. and *Cereus* spp.), *Yucca* spp., *Covillea tridentata*, and *Ephedra* spp. These plants exist under a temperature of 110°–120° in the shade during the summer.

The Mangrove flora of Jamaica (which is especially well developed within the Palisadoes) is composed of four species, *Rhizophora mangle*, *Avicennia nitida*, *Laguncularia racemosa*, and *Conocarpus erectus*. The Palisadoes bear a xerophytic vegetation in which *Cereus* sp. is prominent. On the Blue

Mountains, between 3000 and 7500 feet, there is a well-developed rain-forest. The canopy is dense, epiphytes are numerous (especially Bromeliads), and ferns abound. The island is very rich in ferns, ranging from filmy ferns to tall tree-ferns of the genera *Alsophila*, *Cyathea*, and *Hemitelia*. A climbing bamboo forms one of the most effectual obstacles to rapid transit through the forest. Round about 3000 feet much of the forest has been cleared and planted with the famous Blue Mountain Coffee.

Dr. A. B. RENDLE commented on the interest of the Michigan sand-dunes, the shifting of which was well shown in one of Dr. Chapman's slides showing half-buried poplars and exposed stumps. He could also confirm the extremes of heat supported by the halophytes in the open country round the Great Salt Lake of Utah. The tangled woodlands on the Blue Mountains in Jamaica would prove, when Dr. Maxon's expected monograph appeared, to be one of the world's richest fern-areas, remarkably rich both in terrestrial and epiphytic species. Among the moss on the tree-trunks one found not only filmy ferns but numerous liverworts and mosses. Among the interesting epiphytes was the orchid genus *Lepanthes* (a monograph of which by the late W. Fawcett and himself was published in the Society's Transactions). The tiny plants, sometimes less than an inch in height, were found among the moss on the tree-trunks; at least twenty species were known from Jamaica and an intensive search would doubtless reveal more.

Mr. H. N. RIDLEY suggested that the forests of Jamaica could hardly be described as rain-forest areas as the general tendency of all of Jamaica was xerophytic, and said that the abundance of ferns was in no way to be compared to that of the Malay peninsula or of such localities as Christmas Island.

Mr. I. H. BURKILL remarked that the impression he had received was of rain-forest.

In reply to questions, Dr. CHAPMAN said he was unable to agree with Mr. Ridley in calling the Jamaican forest a dry woodland; the density of the epiphytes, the numerous ferns, and the moisture seemed to determine it as rain-forest. He regretted that he was unable to supply Dr. Rendle with specimens of orchids because he had gone out there primarily to collect marine algae.

4 MARCH 1937

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday 18 February 1937, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Menie Watt and Charles Edmund Ford.

Certificates of recommendation of the following candidates for Fellowship were read :—For the first time, in favour of Hugh Victor Newby, Robert Haynes Jeffers, and Tom Clifford Denston.

The following candidates were balloted for and elected Fellows :—Cecil Henry Hooper, Boris Petrovich Uvarov, D.Sc., Randolph Gordon Ridling, M.A., Eileen Sutton, B.A., Gian Singh Bhatia, M.Sc., Harold Geoffrey Wager, M.A., Ph.D., The Hon. William Jocelyn Lewis Palmer, Margaret Trevena Martin, M.Sc., David Russell, LL.D., Charles Kirke Swann, and Herbert Kenneth Airy Shaw, B.A.

The PRESIDENT reported the deaths of Arthur Reginald Horwood, F.L.S., Dr. Frederic Wilson Stansfield, F.L.S., and Professor Louis Alexandre Mangin, F.M.L.S.

Percy Sladen Expedition to Lake Huleh, Palestine.

By R. WASHBOURN and R. F. JONES.

MR. WASHBOURN described the geographical position of Lake Huleh, and said that its interest lay in the existence in the Jordan Valley of an Ethiopian element of the fauna. This element was restricted to the fish fauna, and Mr. Washbourn described the various theories which had been advanced to account for this. The Percy Sladen Expedition had as its object the investigation of the fauna of this part of the Jordan Valley in the hope of finding further Ethiopian elements. As far as the zoology was concerned, there were none in the collections yet studied.

Mr. JONES stated that the vegetation of the lake was comprised of the more usual species like *Myriophyllum spicatum*, *Potamogeton pectinatus*, *Vallisneria spiralis*, *Najas marina*, etc. In general, many of the species formed pure consociations, each of which was more or less confined to one particular area of the lake. The general features of the Papyrus swamp, with its characteristic species, were described. One species, *Marsilea diffusa*, was recorded as a new species to Asia. In view of its association with the African flora and of the past history of the Jordan Valley, we may suppose that this species is a relict of a former flora of this region.

Dr. A. B. RENDLE, commenting on the flora, suggested that, apart from the Papyrus, *Jussieua repens*, and the African *Marsilea*, the aquatic and marsh plants mentioned were palaearctic. It would be interesting to know what form of *Najas marina* occurred. A complete tabulation of the species with their distribution would show how far the Ethiopian affinity suggested by the fish fauna was represented in the flora.

Miss E. M. BLACKWELL expressed interest in the paper and recalled a visit to Palestine in 1923 when she had collected aquatic plants from Solomon's Pools—three ancient reservoirs in the hills of Judaea between Jerusalem and Hebron. Here she had observed similar pure societies of *Potamogeton pectinatus* and of *Chara* spp. The dominant *Chara* of the lowest pool was *C. connivens*. This species had figured in a scientific report* in the previous year to the medical officer of health in Morocco, where attention was drawn to its larvicidal properties and a recommendation made that it should be encouraged to grow in pools where mosquitoes might otherwise breed. Another African species of great interest collected on this occasion was *Riella helicophylla*. This was found in the lowest pool in great abundance, and exhibiting the perfect spiral form as originally described by Montagne from Algeria. This was in very deep water. Miss Blackwell was collecting in August when the water-level had fallen considerably (it is estimated that 2–3 metres of water evaporate every summer) and the plants were still under water.

Mr. A. G. LOWNDES and Professor E. J. SALISBURY also spoke.

In reply to Mr. Lowndes, Mr. WASHBOURN stated that Entomostraca were not strikingly common. This may have been due to the lateness of the season, or, in the swamps to the lack of oxygen in the water.

* Alluaud, C., 'Rapport à Monsieur le Directeur Général des Services de Santé du Maroc sur une Mission antipaludique', Bull. Soc. Sci. Nat. Maroc, ii, 1–2 (1922).

In reply to Professor Salisbury, he said that chemical analyses were made, but that these were more of a qualitative nature and did not follow the chemical changes of the water on a quantitative basis. The water of Lake Huleh was described as a 'normal Hard water' with a pH varying in the region of 8, moderate carbonate content, and during the daytime a high oxygen content.

In answer to questions Mr. JONES said that the specimens were in the Department of Botany, British Museum, and as many were as yet unidentified it was not possible to give a complete list of species having Ethiopian relationship. With regard to Liverworts these were very scarce and only a few specimens were collected.

The Galapagos Islands.

By WOLFGANG VON HAGEN, M.A., Ph.D.

THE Galapagos Archipelago comprises a group of nine larger islands and a number of smaller ones, mostly in rather close juxtaposition, situated on the equator in the Pacific Ocean about five hundred miles west of the coast of Ecuador and a slightly greater distance south-west of Panama. Albemarle, the largest, is about seventy miles long. The islands belong to Ecuador, and two sets of names are current for nearly every locality—English names given by early English navigators and Spanish names given by the Ecuadorian authorities. The group is of volcanic origin, and volcanic activity continues to the present day on the two westernmost islands. Equatorial heat is modified by the cold Humboldt current from the south, especially on the western side of the archipelago, and at sea-level there is little in the general aspect of things that is suggestive of the tropics. There are wet and dry zones, with heavy rainfall on the summits and southern exposures of the mountains, and there are wet and dry seasons of the year, though these periods are irregular as to dates and amount to speculation. In some sections there are many square miles of lava flow, bare and black, but for the most part the islands are well covered with vegetation. At low elevations the plant covering consists of a large proportion of cactus, including several species that attain to giant size, thickets of mesquite and other plants of similar habit, with mangrove along many of the shores. On the higher slopes there is rain forest, containing trees of large size, hanging orchids, and a tangle of trailing vines. On the summits of the largest islands there are many square miles of grass-land; sometimes the slopes are covered with large ferns. A common tree of attractive appearance is the poisonous 'manzanillo', to be avoided just as carefully as poison oak or poison ivy. Human introduction of garden plants and others has had some conspicuous results.

On Charles Island orange and lemon trees were planted at an early date in a settlement that was later abandoned, and they cover a wide area with a jungle-like tangle, many of the trees having attained a large size. A guava, too, has been introduced, and, in southern Albemarle in particular, it has spread far and wide. As the fruit is greedily eaten by birds, it will doubtless continue to extend the occupied territory. Coconut-palms grow uncared for upon southern Albemarle, and bananas and other fruit have been introduced at various places.

The literature pertaining to the Galapagos is voluminous. Following their discovery they served as a port of call for buccaneers, naval expeditions, and whalers, and the islands feature again and again in the chronicles of these early visitors. Then, later, with the beginning of scientific studies, various aspects of the fauna and flora have been discussed more or less extensively. Recently, pleasure cruises making the Galapagos an objective have resulted in a number of illustrated narratives of varying degrees of excellence.

Human occupancy of the Galapagos dates back perhaps to about the year 1800. An Ecuadorian penal colony was established first upon Charles Island, later upon Chatham, then given up as such, though probably some who were sent there as prisoners remained voluntarily. There were, of course, lurid and tragic episodes connected with this period, some of which have been preserved in printed records. At the summit of Charles Island there is a remarkable system of cave-dwellings surrounded by a jungle of lemon and orange trees that may be supposed to date back to the early prison days.

At the present time the Ecuadorian government centre is situated at Wreck Bay, Chatham Island, a few houses on the beach with a larger community inland at Progreso. On southern Albemarle the Gil family for several generations have raised cattle on an extensive scale; their herds range over the high savannahs for many miles. Here, as on Chatham, there is a settlement on the beach, Villamil, and the agricultural community on the mountain side inland, Santo Thomas. On Indefatigable Island, a group of Scandinavians (formerly on Charles) are endeavouring to establish a fishing industry at Academy Bay, again with an auxiliary settlement inland, called Fortuna. On Charles Island the Ritters (of 'Atlantic Monthly' fame) had their very attractive abode.

The scarcity of fresh water precludes any great increase in the scanty human population now occupying these small settlements. Some of the islands have no water at all, on others the known springs are extremely small. In the settlements rain-water gathered in cisterns is the main resource.

The early history of the islands centres about the presence of the huge tortoises ('Galapagos') from which the archipelago takes its name. If the buccaneers and whalers could find no water, they could find an abundance of fresh meat, and the living tortoises could be kept on board ship for long periods of time. Originally abundant, they were slaughtered by thousands and tens of thousands as food for visiting ships, and later by residents of the islands for their oil. On some islands they are now extinct; it will require prompt and vigorous action, of which there is little promise, if the pitiful remnant is to be saved. The tortoises, formerly of such spectacular interest, were the only large terrestrial animal native upon the islands. As a result of human occupancy, domestic stock of various sorts are now established at many places. Cattle roam over Charles and Chatham, as well as on Albemarle. Donkeys exist on several of the larger islands. Goats on several are especially conspicuous on the open grassy plains of South Seymour. Pigs are common in places, and dogs and cats, running wild, are a serious menace to all smaller life unused to coping with such dangers.

The reptiles are the most conspicuous animals. The tortoises are nearly gone, but the large Iguanas still remain in some abundance locally. The black Sea Iguana is notable in that it is the only amphibious lizard. It is markedly gregarious, and in some places can be found in herds of hundreds, huddled together on the rocks when high tides submerge their pastures of kelp. The land Iguana of about the same size, attaining a maximum length of about four feet, is still abundant on South Seymour, scarce elsewhere. Smaller lizards and geckos are of general occurrence, and an occasional snake is seen, slender and of small size. Snakes, lizards, and the herbivorous iguanas are all harmless, though the last-mentioned are ferocious enough in appearance.

The native land-mammals consist of several species of mice and a bat, all small and nocturnal, to be seen at all only by careful search or a rare chance. There was a former abundance of Fur Seals, now reduced almost to extinction. The beaches still harbour herds of sea-lions, which, like nearly all the island life, are perfectly indifferent to human approach.

Birds are abundant and of great interest to the naturalist, but for the most part they are not spectacular. It is not a tropical assemblage. There are no parrots, no humming-birds, no trogons nor toucans, nor other such gaudy inhabitants of the mainland jungles. Flamingos there are, and these supply almost the only bright colour in the bird-life. There are great numbers of small dusky finches, great numbers of mocking-birds, quantities of doves in some localities, and a few other land birds in more or less abundance. Marine birds

are seen nearly everywhere, swarming in favoured spots. A large albatross colony occupies Hood Island. Two species of gulls, two of frigate-birds, and pelicans, boobies, tropic-birds, petrels, and shearwaters are everywhere searching the sea for food. There are herons, four species, and a native duck in the lagoons, and various kinds of wading birds, some resident, other visitors from the far north. The remarkable flightless cormorant is restricted to Galapagos waters, and there is a peculiar penguin there, too—the only penguin that is found as far north as the equator.

The waters swarm with marine life, and on the beaches platoons of gaudy red crabs deploy like soldiers upon approach. Some of the crabs scuttle away, like desert lizards in their appearance.

The historical importance of the Galapagos Islands rests in the fact of their having been visited by Darwin on the *Beagle* in September and October 1835. With his mind already deeply impressed by the geological and paleontological phenomena spread before him on the South American mainland, he was prepared to grasp some of the significant facts evident in the animal life of this group of islands. The birds in particular were an important element in the field of observations that served to crystallize the evolutionary concepts that were taking shape in his thoughts. In these islands, he wrote, 'we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth'. Surely, to the biologist, there can be few landmarks more deserving of formal recognition than the place whence Darwin drew the first inspiration for his work; nor can one think of more fitting recognition than preservation of the subject-matter of his studies there.

Mr. H. N. RIDLEY pointed out that the absence of coconuts on the Galapagos Islands was probably due either to the unsuitable character of the shores for their growth or from the destruction of the shoot in germination by crabs or other animals. The coconut, apparently a native of Ecuador, has been known to travel much further than to the Galapagos, e.g. to Coco Island, 700 miles from the nearest land, though in that case the nuts had travelled much further.

Sir ALBERT SEWARD regretted that time was too short for any discussion; but he wished to express hearty appreciation of the most interesting account of the Galapagos Archipelago given by Dr. von Hagen, which he was sure everyone had enjoyed. It was no exaggeration to describe the islands as the most important in the world. He wondered what would have happened had Darwin never visited the Galapagos

Archipelago—the ‘Origin of Species’ might never have been written.

Dr. A. B. RENDLE suggested that botanists no less than zoologists were interested in the conservation of the Galapagos Islands, the flora of which showed considerable endemism. The late Prof. Robinson of Harvard and more recently Prof. Skottsberg had made special study of the flora. The remarkable speciality of the tortoises in the different islands described by Dr. von Hagen seemed to be paralleled by that of the *Opuntias* as indicated by his slides.

Mr. J. RAMSBOTTOM also spoke.

Dr. VON HAGEN replied.

The following paper was read in title :—

‘The genus *Potamogeton* L. in Tropical Africa.’ By J. E. DANDY, M.A., F.L.S.

PROCEEDINGS OF THE LINNEAN SOCIETY

(1936-7)

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CATALOGUE OF MANUSCRIPTS, Part II.

The Catalogue of the Manuscripts in the Library of The Linnean Society of London, Part II. Caroli Linnaei Determinationes in hortum siccum Joachimi Burseri. The text of the Manuscript in the Linnaean Collections, edited by Spencer Savage, F.L.S., will be ready shortly for delivery to Fellows and others. This Part of the Catalogue, which is in quarto, extends to 78 pages. The edition is limited to 500 copies.

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